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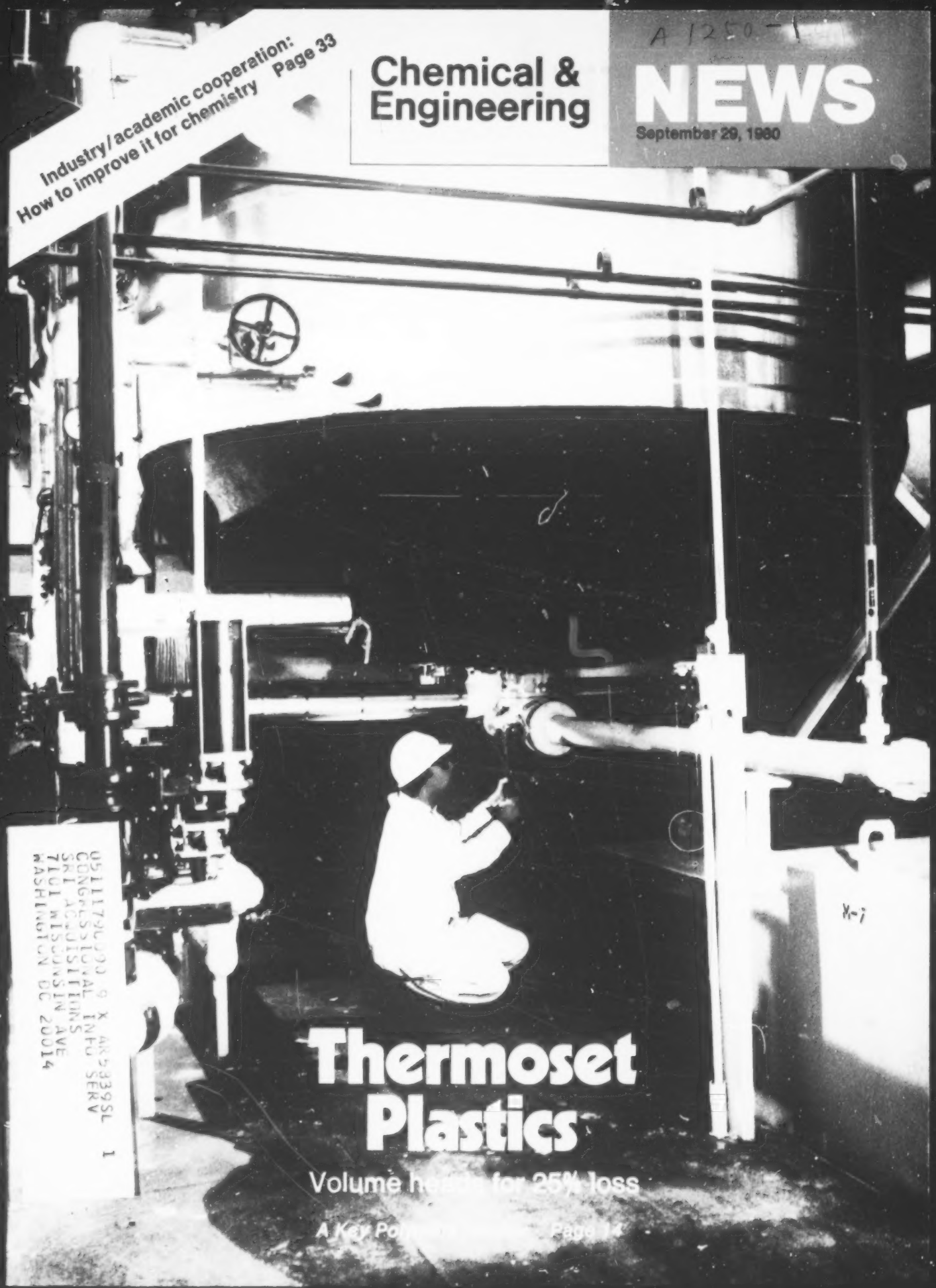
Chemical & Engineering NEWS
September 29, 1980

Industry/academic cooperation: How to improve it for chemistry Page 33



Thermoset Plastics

Volume h[illegible] for 25% loss

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Chemical & Engineering NEWS

Cover: 6700-gal resin kettle, one of the largest in the world, is used in phenolic resin production at Reichhold Chemical's new facility at Niagara Falls, N.Y.

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Thermoset plastics hit hard by recession

Drop in consumer demand for durable goods—thermosets' major markets—is leading to 25% loss in volume; recovery isn't likely until 1982

To economists, the U.S. recession expected in 1979 was delayed to 1980. For producers of thermoset resins, it was dismayingly punctual.

Rises in 1979 inflation and interest rates translated into higher prices for new houses, cars, appliances, and other durable goods—the dominant thermoset markets—as well as higher costs of loans to buy them. Thus for consumer durable goods, and hence for thermoset resins, the decline began in 1979, followed by other segments of the economy in the first quarter of 1980.

The same chilling effects of inflation and interest rates persist in 1980, meaning that thermoset markets will not make quick recoveries. Thus many thermoset producers do not see their sales regaining heights reached in 1978 until 1982 or 1983. In other words, 1981 could be a hard pull.

Among the major thermosets, unsaturated polyester started down first. Production posted a 5% drop from 1.21 billion lb in 1978 to 1.12 billion lb in 1979. The decline began abruptly in April 1979 when lines at gasoline stations formed, reviving memories of the gasoline panic of 1973 and driving down sales of boats and recreational vehicles. The slide continued unabated to the present with successive falloffs in housing starts and domestic sales of U.S.-made autos.

Phenolics followed by midsummer 1979, undercut by falling construction and auto markets, and wound up registering a 6% loss from 1.68 billion lb in 1978 to 1.58 billion lb in 1979, on a 100% resin basis. These figures are somewhat lower than those reported by the U.S. International Trade Commission because C&EN subtracts an estimate for molding compound fillers.

Only epoxy resins held up to the end of 1979. Sales advanced 5% from 1978 to 332 million lb. This upbeat performance in the face of adversity elsewhere results from use of much of epoxy volume for high-performance industrial coatings and for electronic devices. A healthy export market, amounting to 10% of production, also helped offset epoxies' losses.

High inflation rates helped to sap the consumer durables markets on which thermoset sales depend. As measured by the consumer price index, inflation was less than 8% in 1978 but rose to 11% in 1979, with a brief spike to 18% in the second quarter. The inflation rate may continue at about 10% in 1980 and 1981, contributing to further erosion in consumer spending and delaying recovery for one or two years.

High interest rates are another deterrent to consumer buying in the industries where thermoset resins makers sell their products. Such interest rates also chill investment by thermoset customers in production facilities for consumer and industrial goods. The prime rate was 9% in 1978, which itself is not low, and drifted upward in 1979. By the end of 1979, the prime rate was 15% and still rising. The rate shot up to 20% in April 1980, then declined to 11% by midsummer. But interest rose past 12% in September. If persistent inflation leads the Federal Reserve Board to tighten the money supply, the prime could be at 15% at the beginning of 1981, just when thermoset manufacturers hope to turn their falling fortunes around.

Sales of U.S.-produced autos sank 8% in 1979 to 8.4 million units. Some economists estimate the figure could drop another 15% in 1980 to 7.2 million cars. While imported auto sales also will decline somewhat for all of 1980, they may comprise 25% of the U.S. market. These sales of imported cars represent resin markets garnered by foreign producers.

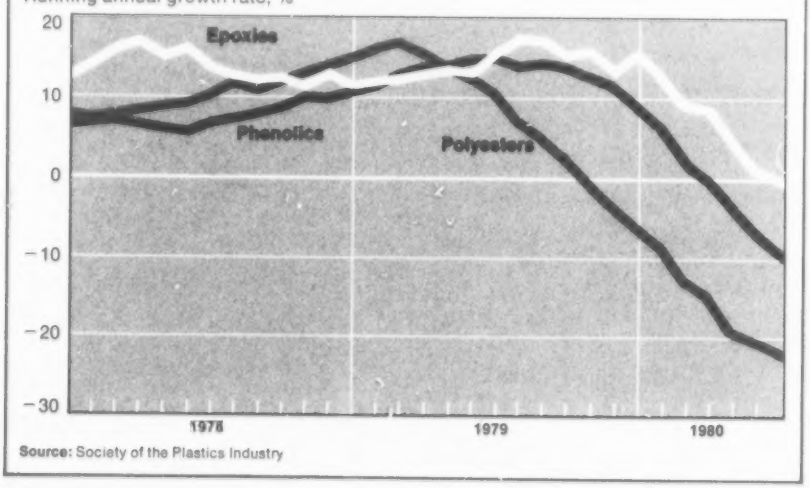
Housing starts dropped 14% in 1979 to 1.7 million units. There may be a further fall of 35% in 1980 to 1.1 million. Persistently high interest rates in 1980 could chill chances for a spring 1981 recovery of this important thermoset market.

These circumstances in interest rates and inflation don't really surprise thermoset producers, who weathered much the same thing before in the 1974–75 recession and to a lesser degree in earlier recessions. The prescription now may also be somewhat like the recovery course from previous recessions—wait it out.

For example, thermosets had to idle through the first recovery year of 1976 after the 1974–75 recession before their markets took off again. The same thing happened in 1971 after the 1970 recession.

Stephen Stinson, New York

Growth slacks off for major thermosets

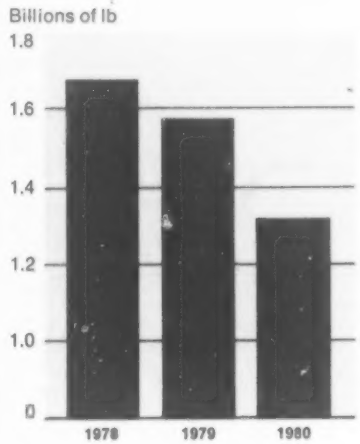


Source: Society of the Plastics Industry

Phenolics

- ***Prices dropping***
- ***Capacity plentiful***
- ***Markets falling***

PRODUCTION



HOW MADE

Condensation of formaldehyde and phenol. One-stage products cured by heating; two-stage products cured by heating with hexamethylenetetramine

MAJOR END USES

Plywood 34%, glass fiber insulation 19%, molding compound 8%, foundry resin 8%, fibrous and granular wood 8%

FOREIGN TRADE

Exports—2% of total production, imports—negligible

PRICES

38 cents per lb, 100% solids basis

COMMERCIAL VALUE

$500 million for total production, 1980

U.S. phenolic resin sales started losing momentum in midsummer of 1979. By the end of the year, the U.S. International Trade Commission had recorded an 8% drop to almost 1.8 billion lb from the all-time high of more than 1.9 billion lb produced in 1978.

The slide continues in 1980, with industry predictions of a further 15 to 20% fall to 1.4 billion to 1.5 billion lb. If continuing inflation and new rises in interest rates prevent early recoveries in important automobile and construction markets, the result could be a 25% decrease to 1.3 billion lb this year.

Recovery likely won't be easy. The phenolic resin industry probably will hit bottom in the first quarter of 1981. But a weak rise in construction in the spring, followed by a delay in auto recovery until 1982 model cars, could limit phenolics sales to 1.4 billion to 1.5 billion lb in 1981. Eventual recovery to 1979 peak levels could come as late as 1983.

With 85% of phenolic resins going to industrial adhesive and bonding applications, these products are highly susceptible to downturns in construction, car sales, and general manufacturing. For example, about 600 million lb of phenolic resins was used to make plywood in 1979, almost 300 million lb as a binder for glass fiber insulation, 110 million lb for laminates, and 140 million lb for fibrous and granulated wood.

In automotive and general manufacturing, about 130 million lb of phenolic resins was used in 1979 as foundry core binder for metal castings. Phenolic molding compound for plastic parts consumed almost 130 million lb of resin to make 310 million lb of compound.

Molding compound sales rose about 3% in 1979 over 1978. This small rise was a weak recovery after an 8% loss in 1978 compared with 1977. The overall trend in molding compounds has continued downward at an average rate of 3% annually since 1976.

Countering this drop, such advances as runnerless molding have made phenolics somewhat more attractive by cutting scrap rates. And continued price increases in thermoplastic molding resins may net more attention for phenolics. Molding compound producers are pinning their hopes on adoption of phenolics by automobile manufacturers in 1981 and beyond as a part of Detroit's efforts to improve gasoline mileage by reducing car weights. Nevertheless, thermoset molding times are longer than those of thermoplastics.

Continued increases in oil and natural gas prices are likely to spur continued growth in phenolic resins for energy-saving glass-fiber insulation. This application grew at annual rates of 15% in the mid-1970's, a rate that may resume with an upturn in construction. Phenolic foam boardstock also has gained interest as insulation because of its thermal insulating efficiency, low flame spread, and smoke generation ratings in comparison with other materials. These products have had minimal sales in the U.S. to date, however.

Phenolic resin producers tried to increase prices over the 1979 average 38 cents per lb on a 100% resin basis during the first quarter of this year. But continuing deterioration of phenolics markets led to a rollback to 1979 levels. Renewed rising prices of oil-derived benzene and especially natural-gas-based methanol and formaldehyde may provoke a rise in phenolics prices to 44 cents in the 1981 recovery year.

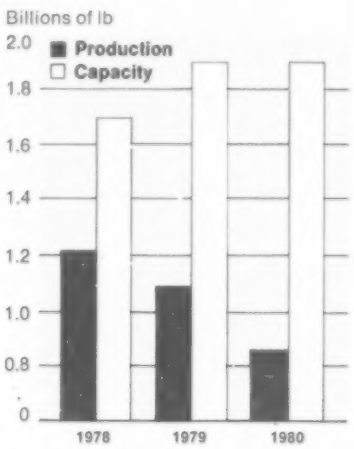
Each 100 lb of phenolic resin takes about 70 lb of benzene in the form of phenol and 40 lb of formaldehyde made from methanol. In addition, laminating varnishes consume 9 million to 11 million gal of methanol diluent yearly. Though under pressure in 1980, list phenol prices are still 50% higher than at the beginning of 1979 and have doubled since 1977. Methanol and formaldehyde list prices also rose 50% in 1979 and 1980 after being quiescent since 1977. Further price rises in methanol and formaldehyde may come in 1981 after this year's holdup.

Production and sales of phenolic resins are hard to gauge because of difficulties in collecting data. Until 1980, some large producers' figures were not accurately represented in monthly figures compiled by Ernst & Whinney for the Society of the Plastics Industry. Both SPI and ITC report on a 100% resin basis, except for molding compounds, which may be 60% fillers. C&EN has used ITC data, after subtracting an estimate for molding compound filler weights, to arrive at production levels of 1.68 billion lb in 1978, 1.58 billion in 1979, and 1.32 billion in 1980.

Polyesters

- ***Prices discounted***
- ***Capacity ample***
- ***Markets plunging***

PRODUCTION/CAPACITY



HOW MADE

Primarily polyesterification of maleic and phthalic anhydrides with propylene glycol; cross-linked with styrene

MAJOR END USES

Construction 29%, marine 20%, castings 14%, transportation 9%

FOREIGN TRADE

Exports—1% of total sales, imports—negligible

PRICES

General-purpose grade, 54 cents per lb

COMMERCIAL VALUE

$460 million for total production, 1980

Unsaturated polyester markets started falling apart in April of last year. The rout began when gasoline lines and an ensuing 25% jump in gasoline prices scuttled marine and recreational vehicle sales. Loss of boat sales has a special impact on polyesters because 65% of the reinforced plastic used in boats is resin, compared with 18% for some other reinforced laminates. Further erosion for polyester occurred with market downturns in construction, automobiles, and appliances.

Last year ended with a 4% drop in polyester sales to 1.15 billion lb, according to figures compiled by Ernst & Whinney for the Society of the Plastics Industry. Sales may fall another 25% to 860 million lb in 1980, though some especially bearish observers see sales plummeting to 720 million lb.

An upturn in most unsaturated polyester markets is expected in the first quarter of 1981, though recoveries in boats and recreational vehicles may be delayed far longer. Sales may reach 1 billion lb in 1981, spearheaded by new applications in auto-body parts, followed by recovery to 1978 levels in 1982. More conservative forecasts are 940 million lb in 1981 with full recovery delayed until 1983.

Some bright spots persisted in polyester markets in 1979. Continued industrial plant construction resulted in a 14% rise to 97 million lb for polyester use in corrosion-resistant tanks and pipes. In addition, use in consumer goods such as recreational products, seating, and serving trays rose 9% to 160 million lb.

In another market—general construction, tank, pipe, and bathroom fixtures—polyester use fell 10% in 1979 to 228 million lb. However, polyester use in imitation marble for vanities rose 15% to 67 million lb, possibly reflecting persistent health in home remodeling and improved marketing efforts by that industry segment.

Overall sales losses for polyester still outpaced these rises in small markets. In the worst area, the marine market fell 9% to 227 million lb in 1979 and lost another 40% in the first half of 1980 from the first half of 1979. Auto, truck, bus, and other transportation applications dropped 12% to 105 million lb last year, and have thudded with another 40% drop so far in 1980. The overall corrosion-resistant market, which flowered late in 1979, is now off 7% year-to-year in 1980.

These troubled times also have dispelled some old myths about recessions. One myth is that when people can't buy new cars, they repair their old ones. But sales of polyester for auto-body putty decreased 9% in 1979 to 45 million lb and 27% so far in 1980.

Another myth is that people remodel their present homes when they cannot build new ones. But polyester use in imitation marble for vanities probably will drop 14% in 1980.

Although only 1.5% of total polyester production is exported by primary resin makers, according to SPI, the U.S. Bureau of the Census reports that almost 10% of U.S. polyester resin eventually winds up abroad through distributors. Of this 111 million lb, almost half went to China in 1979, Census says.

Average U.S. polyester resin prices have fallen from 54 cents per lb in 1979 to as low as 51 cents now. As markets recover in 1981, prices probably will rise toward 60 cents per lb, propelled by increasing raw materials costs. For example, raw material phthalic anhydride is made mostly from *o*-xylene, and raw material maleic anhydride mostly from benzene. The cost of these petrochemicals depends on oil prices.

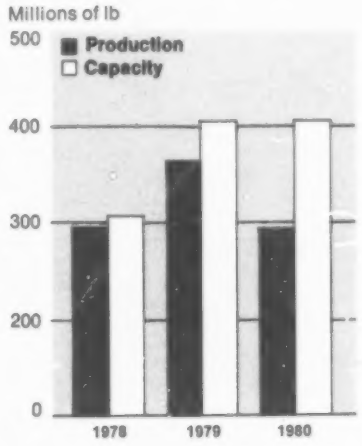
More impetus for rising polyester prices will come from U.S. deregulation of natural gas prices. This will affect polyester raw materials such as propylene glycol. In addition, the U.S. source for maleic anhydride is expected to shift from benzene to natural-gas-derived butane in coming years, dictated partly by Environmental Protection Agency limitations on benzene emissions from maleic anhydride plants.

Other regulatory concerns may add to economic ones for polyester in the coming year. For example, the National Institute for Occupational Safety & Health is expected to recommend to the Occupational Safety & Health Administration that the present 100-ppm, eight-hour worker exposure limit to styrene vapor in plant air be decreased to as low as 25 ppm. The industry will counter with data from a study suggesting that no health advantage will accrue from the change.

Epoxies

- ***Prices steady***
- ***Capacity adequate***
- ***Markets slipping***

PRODUCTION/CAPACITY



HOW MADE

Reaction of bisphenol A with epichlorohydrin followed by cross-linking with hardeners

MAJOR END USES

Coatings 44%, laminates and composites 18%, molding 9%, flooring 6%, adhesives 5%

FOREIGN TRADE

Exports—11% of sales, imports—negligible

PRICES

Average $1.00 per lb

COMMERCIAL VALUE

$295 million for total production, 1980

Epoxies did not begin to feel the chill of the current U.S. economic downturn until the end of 1979, when sales growth was still at a 5% annual rate. This relative resistance to economic weakness, characteristic of epoxies, results from reliance on high-performance, high-technology uses compared with those of other thermosets. Such uses include semiconductor devices, adhesives and parts for airframes, industrial and beverage can coatings, and tanks and pipes for the oil and chemical industries.

But even epoxies fell victim to the overall slowing of the economy in 1980. The running annual growth rate fell to zero by August. By the end of the year, production and sales may be 18% lower than in 1979. With recovery impeded by continuing high inflation and interest rates, epoxy resin production may not return to 1979 levels until 1982.

According to figures compiled by Ernst & Whinney for the Society of the Plastics Industry, epoxy resin sales increased 5% in 1979 to a record 332 million lb. Growth resulted from a 13% rise in flooring use to 20 million lb, an 11% increase in laminates and composites to 54 million lb, and a 3% lift in coatings to 146 million lb. These gains offset small declines in adhesives to 17 million lb and in casting resins to 31 million lb. Though almost all markets now have turned down, laminates and composites continue strong growth, buoyed by the electronics industry.

Epoxies also have a vigorous export market compared with other thermoset resins. According to SPI, 10% of total production was exported in 1979 by base resin makers, and this strength has continued this year. The Bureau of the Census, which counts eventual resin exports by all firms including distributors, reports exports of 22% of all production. Part of this strong export picture results from lower prices of raw materials in the U.S., as well as high efficiencies of a few large U.S. plants.

Most of this burgeoning foreign market results from export of U.S. electronics and coatings technology. Users of these technologies in other countries often specify the same resin that was used successfully here. In addition, epoxy markets in many countries are too small to support domestic epoxy production. Thus exports from the U.S. will continue from large, efficient plants until local foreign consumption justifies domestic plants there.

Beyond the current recession, prospects for epoxies seem especially bright. Manufacturing customers use these high-priced, high-performance resins because they have to, not because they want to, in order to get better product properties. Epoxies cost two to three times as much as phenolics or unsaturated polyesters for adhesives, coatings, and molded parts. Thus, among major thermosets, epoxies are most likely to open up whole new high-specification major market categories while defending themselves against losses to competing materials.

Government regulation may give birth to some of these important new uses. For example, pressure to change from solvent-based to high-solids, water-based, or powder coatings in many industries could lead to penetration of these industries by epoxies at the expense of other resins. Whether it is ever made law, the current trend of auto makers toward offering warranties against corrosion is likely to increase use of epoxy coatings on cars.

Like other thermoset producers, epoxy makers have high hopes that Detroit will choose their products for heat- and stress-resistant parts to reduce automobile weight in the early 1980's. Epoxies certainly have the properties for these end uses, but whether their cost-performance ratios will excel those of phenolics or polyesters is still an open question.

The toxicity picture for epoxy resins also seems brighter this year. Although concern has arisen over possible carcinogenicity of residual epichlorohydrin in base resins, cooperative industry studies soon may be released that indicate negligibly low levels in the air of well-ventilated fabricating plants that use good work practices. These levels are well below the 5-ppm eight-hour standard set by the Occupational Health & Safety Administration.

Suspicions of carcinogenicity also may have been lifted from butyl glycidyl ether, a diluent used in many epoxy formulations. A 1979 report at the University of Texas of older studies suggests that the diluent is not mutagenic in animal skin painting tests.

Canadian chemicals growth slows sharply

The rapid pace of growth maintained by the Canadian chemical industry for the past three years now has slowed to a crawl, for the most part.

Although most of Canada's largest publicly reporting chemical companies could boast of increased sales and earnings in the first half of 1980 (C&EN, Aug. 11, page 16), those boasts were couched in terms of dollars. In terms of real output, the trend has been one of stagnation, according to figures from Statistics Canada.

The chemical production index showed small monthly increases from July 1979 through March 1980. But April brought a sharp drop in the index, followed by a slight rebound in May and another drop in June. At the end of June, the index was only minimally higher than it was a year earlier. At least it was an increase; the all-industry index declined about 4% during the same period.

Trends notwithstanding, production of some chemicals, including fertilizers (making a strong comeback after a lackluster 1979), caustic soda, chlorine, major acids, and ethylene, increased substantially during the first half of 1980. But production of benzene was down slightly during the period. Production of butadiene and carbon black was off significantly, reflecting the tire industry's current hard times. And after four years of whopping gains, all the major plastics also posted production declines.

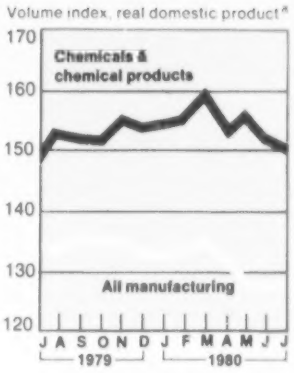
Chemical prices rose slowly during the second half of 1979, then jumped sharply at the beginning of 1980. Producers' quarterly adjustments brought another, smaller leap in April. In June, the chemical price index actually dropped just a bit, although it inched upward again in July, according to preliminary figures. At the end of July, the index was about 17% higher than it was a year earlier; it appears unlikely, however, that that rate of increase will persist in the next several months. The chemical price index continues to run slightly ahead of the all-industry index.

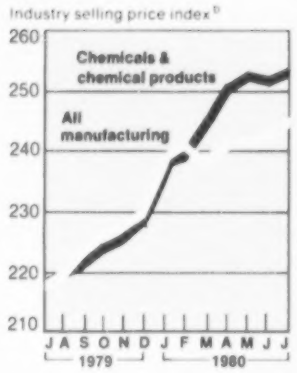
Canada's chemical exports continue to run strong; in fact, much of the good news in second-quarter sales and earnings reports was attributed to booming export sales. Exports were particularly strong for fertilizers, organic chemicals, and synthetic rubbers and plastics. At the same time, the trend of chemical imports has been downward, and Canada's chemical trade balance is, at least for the present, solidly in the black.

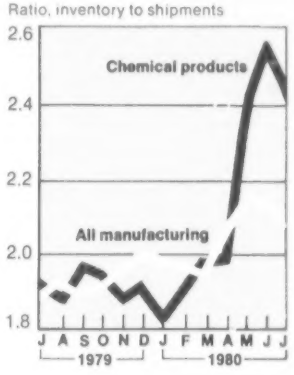
The spring slowdown put a dent in the Canadians' resolve to keep inventories under control. Chemical shipments, even in terms of inflated dollars, actually declined in May and June. At the same time, inventories rose steadily. The inventory-to-shipments ratio, after having fluctuated within tolerable limits (less than 2.00) for most of the period, suddenly jumped to an unnerving 2.43 in May and rose again to 2.57 in June. Preliminary figures for July show only a marginal change in the ratio (to 2.46), but at least the change is in the right direction. The all-industry ratio also has risen, but not so sharply.

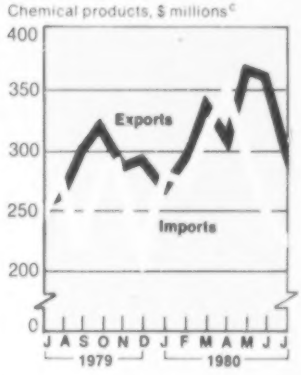
Despite some signs that the recession may have "bottomed out," most Canadian economists are gloomy about the near-term outlook. In general, they predict that 1980 will be a "no-growth" year for Canada, and that there will be only slight recovery in 1981.

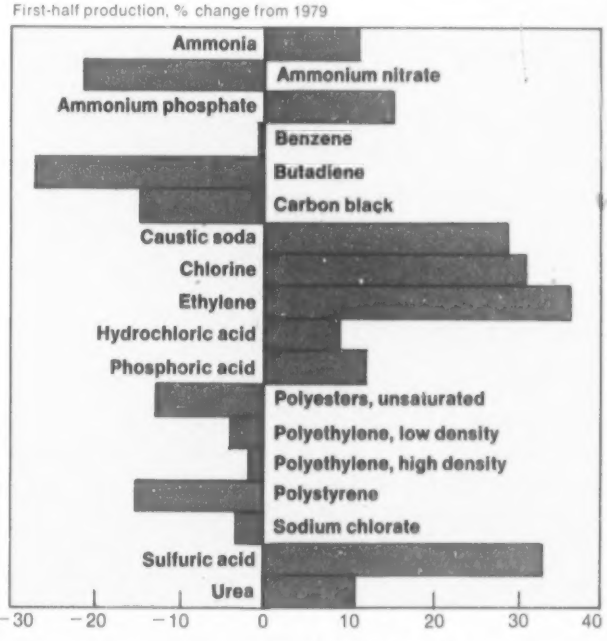
Ward Worthy, Chicago











a Seasonally adjusted; 1971 = 100. b 1971 = 100. c Canadian dollars.
Source: Statistics Canada